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Lamiglas
Woodland, Washington

NIOSH Investigator:
Arvin G. Apol

I SUMMARY

In October 1985, the National Institute for Occupational Safety and Health (NIOSH) received a request from the management of Lamiglas, Woodland, Washington, to determine the employees' health risks and solvent vapor exposures during the manufacture of fibrous glass and graphite fishing rods.

An initial survey was conducted on October 29, 1985; an environmental survey was conducted on February 12-13, 1986. An interim report was submitted on Lamiglas on July 11, 1986.

Eighteen personal breathing zone samples and four general area samples were collected to determine the workers' exposures to the various solvent vapors used in their respective jobs. The solvent vapor concentrations ranged from 3 to 59% of the appropriate evaluation criteria. The coater, blank washer, silk screener, set up worker and finisher reported occasional health effects of headache, dizziness and lightheadedness which can be caused by exposures to the solvents used. Although the concentrations measured were less than the criteria, they could be elevated under some conditions resulting in the health effects reported.

Dermatitis resulting from skin contact with the high temperature cure resins and the epoxy glue used in rod building has occurred in the past
and the potential for reoccurrence is still present.

On the basis of the data obtained from this investigation, it has been determined that 1) the workers in the blank and rod building departments may occasionally be exposed to solvent vapors in sufficient concentrations to produce headaches, dizziness and lightheadedness and also to epoxy resin that, upon direct contact with the skin, can produce dermatitis, and 2) the silk screener is exposed to the silk screen cleaner materials that are aerosolized during application resulting in nasal and throat irritation and occasional bleeding.

Recommendations to reduce exposure to the solvent vapors and aerosols through the use of engineering control and to epoxy resin contact through the use of good personal hygiene and protective clothing are listed in Section VIII of this report.

KEYWORDS: Sic 3949 (Sporting and athletic goods - fishing tackle, acetone, 2 butoxyethanol, N-butyl alcohol, cyclohexanol, epoxy resins, fiberglass, graphite, petroleum distillates, toluene, xylene.

II INTRODUCTION

In October 1985, the National Institute for Occupational Safety and Health (NIOSH) received a request from the management of Lamiglas, Woodland, Washington, to determine the employees' health risks and solvent vapor exposures during the manufacture of fibrous glass and graphite fishing rods.

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III BACKGROUND

Lamiglas, Woodland, Washington, manufactures fiberglass and graphite fishing poles.

Blank production--Various size pieces of material are cut from either fiberglass sheets or graphite fiber sheets that have been impregnated with a high temperature cure epoxy resin. The material is attached to a mandrel by heating an edge with a handheld heating iron while it is touching the mandrel. The mandrel with the attached material is placed on a rolling table and the material is tightly rolled on the mandrel to form a blank. It is then wrapped with a heat shrink plastic. A number of these blanks are loaded vertically in a rack and placed in an oven and heated to 400°F. to cure the resin. After cooling the blanks are removed from the mandrel, the heat shrink plastic is removed and the blank is wet sanded. The blanks are then coated with either a clear or colored coating, dried in an oven and trimmed to the appropriate length. The complete blanks proceed to the rod shop where cork handles are fitted and glued on using an epoxy glue. The make and model labels are applied with a silk sreen process. The guides are attached to the rods by wrapping thread over the guide ends, followed by the application of an epoxy coating over the threads and allowed to cure. The completed rod is then packaged and shipped.

There are approximately 50 employees in the production shop. The jobs and the chemicals they are exposed to are discussed in Section VI of this report.

IV EVALUATION DESIGN

A. Environmental

Environmental breathing zone air samples were collected over a two day period to determine the employees' exposures to one or more of the substances listed below:

Substance	Collection Method	Flow Rate	NIOSH Analytical Method
Acetone	Charcoal tube	50 cc/min	1300
2-Butoxyethanol (ethylene glycol monobutyl ether)	Charcoal tube	50 cc/min	P&CAM 127
Butyl alcohol	Charcoal tube	50 cc/min	1401
Cyclohexanol	Charcoal tube	50 cc/min	P&CAM 127
Petroleum distillates	Charcoal tube	50 cc/min	1550
Toluene	Charcoal tube	50 cc/min	1501
Xylene	Charcoal tube	50 cc/min	1501

B. Medical

The medical evaluation consisted of a short questionnaire administered by the NIOSH investigator regarding employees' past and present health effects consisting of headache, dizziness, nausea, lightheadedness, skin rash, dermatitis and others.

V EVALUATION CRITERIA

A. Environmental Criteria

As a guide to the evaluation of the hazards posed by workplace exposures, NIOSH field staff employ environmental evaluation criteria for assessment of a number of chemical and physical agents. These criteria are intended to suggest levels of exposure to which most workers may be exposed up to 10 hours per day, 40 hours per week for a working lifetime without experiencing adverse health effects. It is, however, important to note that not all workers will be protected from adverse health effects if their exposures are maintained below these levels. A small percentage may experience adverse health effects because of individual susceptibility, a pre-existing medical condition, and/or a hypersensitivity (allergy).

In addition, some hazardous substances may act in combination with other workplace exposures, the general environment, or with medications or personal habits of the workers to produce health effects even if the occupational exposures are controlled at the level set by the evaluation criterion. These combined effects are often not considered in the evaluation criteria. Also, some substances are absorbed by direct contact with the skin and mucous membranes, and thus potentially increase the overall exposure. Finally, evaluation criteria may change over the years as new information on the toxic effects of an agent becomes available.

The primary sources of environmental evaluation criteria for the workplace are: 1) NIOSH Criteria Documents and recommendations; 2) the American Conference of Governmental Industrial Hygienists' (ACGIH) Threshold Limit Values (TLV's); 3) the U. S. Department of Labor (OSHA) occupational health standards; and 4) the Washington Industrial Safety and Health Agency (WISHA) Standards. Often, the NIOSH recommendations and ACGIH TLV's are lower than the corresponding WISHA or OSHA standards. Both NIOSH recommendations and ACGIH TLV's usually are based on more recent information than are the OSHA standards. The OSHA standards also may be required to take into account the feasibility of controlling exposures in various industries where the agents are used; the NIOSH-recommended standards, by contrast, are based solely on concerns relating to the prevention of occupational disease. In evaluating the exposure levels and the recommendation for reducing these levels found in this report, it should be noted that industry is legally required to meet only those levels specified by an OSHA standard.

A time-weighted average (TWA) exposure refers to the average airborne concentration of a substance during a normal 8- to 10-hour workday. Some substances have recommended short-term exposure limits or ceiling values which are intended to supplement the TWA where there are recognized toxic effects from high short-term exposures.

Substance	NIOSH or (ACGIH) Recommended Criteria 10 Hr TWA	WISHA and/or OSHA Standards 8 Hr TWA	Health Effects
Acetone	250 ppm	1000 ppm	Irritation of eyes, nose, throat; headache; dizziness; dermatitis
2-Butoxyethanol (ethylene glycol monobutyl ether)	25 ppm skin (ACGIH)	50 ppm skin	Irritation of eyes, nose and throat
Butyl alcohol	50 ppm skin (ACGIH)	100 ppm	Irritation of eyes, nose, throat; dizziness; headache; drowzy; dry cracked skin
Cyclohexanol	50 ppm (ACGIH)	50 ppm	Irritation of eyes, nose, throat; narcosis; irritation of skin
Petroleum Distillates	350 mg/cu m Approx 90 ppm	500 ppm	Irritation of eyes, nose, throat; dizziness, drowsiness; headache; nausea; dry cracked skin
Toluene	100 ppm 20 ppm	200 ppm 10 min ceiling	Dizziness; headache; nausea; impairment of coordination and reaction time
Xylene	100 ppm 200 ppm	100 ppm 10 min ceiling	Irritation & dryness of eyes, nose, throat & skin; dizziness; headache, nausea; vertigo; impaired memory

VI RESULTS AND DISCUSSION

A. Environmental

The workers' exposures to the chemicals used in various jobs follows. The sample results are shown in Tables 1 and 2.

Blank Shop - The pattern cutters, tackers, rollers and wrappers have contact with the high temperature curing epoxy resins impregnated in the fiberglass and graphite sheets. Skin contact with this material has produced contact dermatitis with several of the current workers. Rubber gloves used along with cotton liners (undertaker's gloves) by these workers will aid in the prevention of dermatitis. A fume is produced when the tackers attach the material to the mandrel with a hot iron. This fume passes through the tackers' breathing zone. Samples of this fume collected with the same materials at another fishing rod manufacturer, were analyzed for alephatic and aromatic amines, but were below detectable levels. The manufacturer of this material was contacted, but they have not been able to identify the components of the fume produced during the tacking and also during the curing process. The tacking tables should be equipped with slot ventilation along the back of the table to remove the fume as it is produced. Lowering the temperature of the iron with a rheostat will reduce the amount of fume generated. The tacker also is exposed to acetone vapors. On the day of sampling, the acetone concentration was 20 ppm which is 8% of the evaluation criteria. The rollers' exposure to acetone vapors during the wipe

down of the rolling tables was 21 ppm or 8% of the evaluation criteria.

The coater is exposed to the solvents present in the coating materials. They include acetone, n butyl alcohol, toluene, and xylene. When two or more substances are present that produce similar health effects, the combined exposures must be considered as additive. A separate evaluation criteria is then calculated for each sample based on its constituents. The coaters' combined exposure for two days were 32% and 25% of this evaluation criteria. During one sample period the coating material accidently splashed into the face of the coater. The safety goggles he was wearing prevented a potentially serious eye injury. The use of eye and face protection cannot be overemphasized. The blank washer washes the blanks with acetone and is in and out of the coating area. The blank washers' exposure to the same combined solvents as the coater was 41% and 45% of the combined evaluation criteria. This person was observed carrying an open 5 gallon container of acetone. Solvents, both flammable and non-flammable, should only be carried in self-closing containers. The coater, a former coater and the blank washer have experienced headaches, dizziness, and lightheadedness. Although the solvent vapor exposures ranged from 25 to 45% of the evaluation criteria on the days of sampling, the potential exists for several hours of increased exposures that could produce these health effects.

The blanks are placed in the curing oven to cure the epoxy resins at a high temperature. Fume is emitted from the oven during the cure. Some of the fume is exhausted outdoors, and some enters the work area. Several employees, as noted in the medical section of this report, occasionally experience eye and throat irritation from the fumes. Slot exhaust ventilation around the edge of the door would capture the fumes emitted from the oven.

Rod Shop - The set up workers are exposed to epoxy resins and toluene. The airborne toluene vapor exposures ranged from 23 to 59 ppm which is less than the evaluation criteria of 100 ppm. These workers have experienced headache, dizziness, and lightheadedness which are consistent with toluene exposure. Although these concentrations are less than the criteria, the use of local exhaust ventilation, e.g., slot ventilation along the center of the table, would prevent the vapors from the toluene and the epoxy resins from passing through the breathing zone of these workers.

The silk screener is exposed to the solvents present in silk screen paints and screen cleaning solvents which are applied from a spray can. The combined solvent exposure was 27 and 31% of the combined evaluation criteria for the solvents present. Because the cleaner is used as a spray, an aerosol is produced which probably produces the occasional nasal and throat irritation and bleeding. Local exhaust ventilation should be installed directly behind the silk screen rack and the spray cleaner should be sprayed directly toward this ventilation.

The finishers use small amounts of epoxy resin and brush cleaners. The solvent exposures consisted of a combination of toluene, xylene, and aliphatic hydrocarbons and was only 3% of the evaluation criteria.

B. Medical

Eighteen workers in the blank shop were administered the questionnaire. Their time with Lamiglas ranged from four days to four years with eight having worked less than six months. The two pattern cutters were new hires and at present had not had any health effects. Six workers had one or more occasions of a skin rash. Four were tacking and two were floaters. They had no other health effects while tacking. Three workers, one currently coating and one former coater and one washing and sanding blanks, reported occasional headache, lightheadedness and dizziness. Two had eye and throat irritation from smoke escaping from the curing oven.

Eight workers in the rod shop were administered the questionnaire: 1 silk screener; 4 set up; and 3 finishers. The silk screener's exposure consisted of solvent vapors of cyclohexanol, 2-butoxy ethanol and petroleum distillates. This worker occasionally experienced headaches, sore throat and a sore nose

that would become raw and bleed. The silk screen cleaner was used from a spray can which generated an aerosol. The inhaled aerosol contacts the nasal and throat area resulting in irritation, coughing and bleeding. After observing the silk screen cleaning process, it is felt that the exposure is the cause of the health effects.

All four of the set up workers experienced headaches with one on almost a daily basis; two occasionally feel lightheaded and dizzy; and two had dry hands. These symptoms are compatible with exposure to toluene vapors and liquids. One had a skin rash associated with epoxy resins. They did relate that there have been some who worked in the set up area for several weeks, but would leave due to skin rashes (dermatitis) and swollen eyes.

The finishers mix and apply small amounts of epoxy over the guide threads. One, on a single occasion, had a skin rash and another had dry hands. One occasionally has symptoms compatible to exposure to solvents in the brush cleaner or in the silkscreen operation located nearby. The finisher also stated that several workers had to leave the job due to skin rashes.

VIII SUMMARY AND CONCLUSIONS

The employees' exposure to the various solvent vapors ranged from 3 to 59% of the appropriate evaluation criteria. The employees reported occasional health effects associated with exposure to the solvents used. Although the concentrations measured during the sampling period were less than the criteria, the solvent vapor concentration could be elevated under some conditions resulting in the health effects reported. Local exhaust ventilation at the processes where the solvents are used could prevent elevated concentrations. Dermatitis resulting from skin contact with the high temperature cure epoxy resin and the epoxy glue used in rod building has occurred in the past. Good personal hygiene and protective clothing can reduce the incidence of this occurring.

IX RECOMMENDATIONS

1. Provide local exhaust ventilation on the following processes:

    a. tacking tables;

    b. blank washing;

    c. around the door seals of the curing oven;

    d. rod building set up;

    e. silk screen cleaning.

2. Lower the temperature of the hand held iron used for tacking. A large rheostat that the iron can be plugged into could work very well.

3. Label all solvent containers and use only safety cans and plunger cans for transferring and dispensing the solvents. All open containers of flammable solvent need fuse linked self-closing lids.

4. Persons who handle and work with epoxy resins should wear protective gloves with liners. Cotton (undertakers) gloves work well as glove liners.

5. Any epoxy resin that contacts the skin should be washed off immediately. Conveniently located wash basins will be more readily used by the workers.

6. Occasionally a number of cork handles have to be removed from completed rods. These should be removed by machine rather than by handheld knives. The movement of the hands and wrists when using knives creates a potential for carpal tunnel syndrome by the user.

X AUTHORSHIP AND ACKNOWLEDGEMENTS

Report Prepared by: Arvin G. Apol, C.I.H., M.S.
Industrial Hygienist
NIOSH, Region X
Seattle, Washington

Originating Office: Hazard Evaluation & Technical Assistance Branch (HETAB)
Division of Surveillance, Hazard Evaluation & Field Studies (DSHEFS)
NIOSH, Cincinnati, Ohio

XI DISTRIBUTION AND AVAILABILITY

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Copies of this report have been sent to:

1. Lamiglass, Inc., Woodland, Washington
2. Washington State Department of Labor and Industries, Olympia, WA
3. U. S. Department of Labor/OSHA - Region X
4. NIOSH - Region X

For the purpose of informing affected employees, a copy of this report shall be posted in a prominent place accessible to ther employees for a period of 30 calendar days.

Table 1
Acetone, N-Butyl Alcohol, Toluene, Xylene
Air Concentrations in the Blank Shop
Lamiglas, Inc.
Woodland, Washington

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Job or Location	Date	Sample Number	Sample Time Minutes	Sample Volume Liters	Acetone ppm	N-Butyl Alcohol ppm	Toluene ppm	Xylene ppm	*Total equivalent exposure of mixture times the evaluation criteria	
Coater	2-12-86	2	224	10.6	35	2.8	0.2	9	0.29	
										0.32
Coater	2-12-86	9	212	9.9	46	3.7	0.3	10	0.36	
Coater	2-13-86	12	210	13.9	22	2.9	0.2	12	0.27	
										0.25
Coater	2-13-86	20	212	14.0	19	3.3	0.2	9	0.23	
Coater Area Upstairs	2-12-86	3	229	12.0	6	1.4	§0.2	4	0.09	
Coater Area Downstairs	2-12-86	10	247	13.7	21	8.0	0.6	20	0.45	
Coater Area Upstairs	2-18-86	21	252	11.9	2	2.2	§0.2	7	0.12	
Coater Area Downstairs	2-13-86	13	212	9.7	15	7.0	0.6	19	0.40	
Blank Washer	2-12-86	1	228	12.3	71	0.8	0.2	2	0.32	
										0.41
Blank Washer	2-12-86	8	214	11.6	115	0.9	§0.2	2	0.50	
Blank Washer	2-13-86	11	209	11.1	101	0.6	§0.2	1	0.43	
										0.45
Blank Washer	2-13-86	19	212	11.4	106	0.9	§0.2	3	0.47	
Blank Roller	2-12-86	4	423	19.6	21	-	-	-		
Tacker	2-13-86	14	420	15.3	20	-	-	-		

*When there are 2 or more substances present that have similar health effects, the exposure levels are combined and a new exposure criteria is calculated for this sample. Any value greater than 1.0 indicates that this criteria was exceeded.

Table 2
2-Butoxyethanol, Cyclohexanol, Petroleum Distillates
Air Concentrations

Lamiglas, Inc.
Woodland, Washington

HETA 86-037

Job or Location	Date	Sample Number	Sample Time Minutes	Sample Volume Liters	2-Butoxy Ethanol ppm	Cyclo-hexanol ppm	Petroleum Distillates ppm	Toluene ppm	*Total equivalent exposure of mixture times the evaluation criteria
Silk Screener	2-12-86	7	412	26.6	5	§0.4	10	-	0 31
Silk Screener	2-13-86	15	230	11.9	4	§0.6	13	-	0.30 .27
Silk Screener	2-13-86	22	189	10.0	3	§1.0	10	-	0.23
Set Up	2-12-86	5	420	23.1	-	-	-	59	
Set Up	2-12-86	6	420	24.1	-	-	-	35	
Set Up	2-13-86	16	417	22.7	-	-	-	38	
Set Up	2-13-86	17	382	19.8	-	-	-	23	
Finisher	2-13-86	18	410	23.3	-	Xylene 0.1 ppm	Aliphatic Hydrocarbon 1 ppm	Toluene 2	.03

*When there are 2 or more substances present that have similar health effects, the exposure levels are combined and a new exposure criteria is calculated for that sample. Any value greater than 1.0 indicates that the exposure criteria was exceeded.